APPENDIX 3

ASSESSMENT METHODS SUMMARY

Fish and Game Methods

This assessment correlated habitat loss trends from CDFG stream surveys spanning different time periods throughout tributary sub-basins, with land use patterns, and noted direct sedimentation inputs by timing with peak flow events. Scale of shade canopy depletion is compared between 1942 and present. Current habitat conditions (pool depth and frequency, % shade canopy cover) are geographically shown to infer relationships of current fisheries populations with, (1) stream temperatures, (2) sedimention (McNeil sampling, embeddeness, and substrate type (D_{50}). and (3) unstable areas and slide locations. Changes in fluvial geomorphology shows timing and direction of sediment transport downstream.

Water Quality Methods

The RWQCB compiled and evaluated existing data that were available as well as collected some new water quality data. The data analysis included in this assessment by RWQCB is for basic water chemistry, water temperature, and sediment parameters. The data gathering, data collection, and data analysis techniques are detailed in our methods manual, NCRWQCB (2001).

<u>Data Gathering</u>

Data gathering is the process of compiling existing data from Regional Water Board files, other agency files, and other sources. The Regional Water Board has several types of water quality information sources within its office, all of which were evaluated for inclusion into the assessment: Timber Harvest Plan files, water quality monitoring files, TMDL files, grant files, EIRs and other reports. Sources outside the office included data and reports from other agencies (including water rights and diversion information), US EPA's StoRet water quality database, watershed groups, landowners, and public interest groups. As data were gathered, the location and general characteristics of the data were catalogued in a computerized database. Catalogued data included non-water quality data related to the watershed assessment that we made available to the other NCWAP agencies as requested.

<u>Data Collection</u>

RWQCB staff collected water quality measurements three times during 2001 in the Gualala River watershed. Sample collection and analysis was in accordance with methods used by USGS and USEPA. Those methods are further explained and referenced in the RWQCB's NCWAP methods manual (NCRWQCB 2001). While staff had hoped to collect stream channel information, such as pebble counts, we were unable to accomplish this due to access and resource constraints. However, the Gualala River Watershed Council (GRWC) in cooperation with the Gualala Redwoods, Inc. (GRI) collected those types of data at a number of locations in the watershed. Additionally, a GRWC/RWQCB joint effort in temperature monitoring resulted in additional sites being monitored as well as the collection of air temperature data for future modelling activities.

<u>Data Analysis</u>

The data were computerized into formats appropriate for the information, e.g., spreadsheets for dissolved oxygen, flow, temperature. Analysis of the data was specific to the data type and its quality. For example, water temperature data from continuous data loggers were evaluated from raw data plots (when available) over time and cumulative distribution plots against water quality criteria or water quality objectives (WQOs) to determine frequency of exceedances (percent of observations and number of days), duration of exceedances (how many hours was a particular standard exceeded in a day), and maximum daily excursions. Additionally, summary statistics were compared to the proposed limiting factors thresholds: MWAT, the maximum 7-day floating average temperature for the summer season for a site and the Seasonal Maximum for a site. The thresholds were 50-60 F proposed as "fully supportive of salmonids" for MWAT, and 75 F proposed as lethal for salmonids. Where we did not have the full raw data set for continuous temperature measurements, we evaluated only the summary statistics.

For sediment parameters, we used data available for streambed cores and pebble counts. The primary metrics were: D_{50}, median particle size from pebble counts, and percent fine material in core samples <0.85 mm and <6.4 mm. We compared D_{50} values to Knopp (1993), who studied north coastal streams and found in 18 index streams (streams with little or no land management activities for 40 years) D_{50}s ranging from 37 to 183 mm, with a mean of 69 mm. Core data were compared to the proposed Gualala TMDL targets of less than 14% and less than 30% for particle sizes of 0.85 and 6.4 mm, respectively.

As the synthesis of data proceeded, these data were evaluated with respect to influential factors to the extent they were available, such as canopy for temperature and land use and erosional feature along with fluvial geomorphology for sediment. To the extent data arrays, staffing, and time limitations allowed, it was an interdisciplinary effort in recognizing and hypothesizing the linkages and understanding the data more fully and in a broader context.

Data Quality and Limitations

We evaluated existing data for quality with respect to the assessment, and new data collections were at a level to ensure utility in the assessment.

- Water temperature and stream channel measurements provided by the GRWC and GRI were collected with acceptable methods and quality assurance and control for use in the assessment. However, we were unable to evlauate the data in raw form in most cases because it either was not provided or staffing and time constraints prevented that analysis
- NCRWQCB's water chemistry analysis was limited to available USEPA StoRet data for the period April of 1974 to June of 1988 at three locations, and three samples obtained by NCRWQCB at five locations in 2001. The sampling frequency and small number of locations did not allow for any detailed temporal analysis.
- Pesticide data were not available from StoRet, nor collected in the NCRWQCB sampling of 2001.
- Collection of additional water quality data on daily dissolved oxygen, pH, conductance, and temperature at locations near the confluences of major tributaries did not occur due to access limitations.
- NCRWQCB analyzed water temperature and in-channel data supplied by the GRWC and GRI for the period from 1992 to 2001. Not all locations received sampling throughout that period, limiting the ability to compare across years and among sites.
- In-channel data and some most temperature data were provided as summary statistics (medians, means, maxima), limiting the ability to factor variability into the analysis, and not allowing for independent checks on the data quality. As such, the analyses and subsequent assessment are limited in scope.
- Analysis of temperature information is without knowledge of the extent of a thermal reach upstream of the continuous data logger.
-
- The water quality data gathered in the past and more recently in 2001 were adequate for the analysis performed and provide a general sense of the basic water chemistry.
- Turbidity and suspended solids data were not available, though critical to water quality assessment.
- The primary limitations to the data we evaluated were related to matters of scale—that is, the representativeness of a measurement in a specific location with respect to characterizing a subwatershed. In that context, the data often determine the coarseness of the assessment as some data are more appropriately applied over a larger area than others.

Although there is controversy regarding the utility of streambed substrate data, pebble counts and core samples can provide a perspective on the composition and dynamics of the streambed. Conditions in a riffle may vary considerably, requiring large sample sizes to quantify the conditions for salmonids. However, the pebble count and core sample results for the Gualala River watershed were useful in providing an idea of streambed conditions and to add validity to other observations, such as the embeddedness and dominant particle sizes data from habitat surveys.

<u>Methods used by GRI and GRWC</u>
Riparian condition was inventoried by GRI and GRWC in two ways:

Canopy cover percent was measured with a vertical densiometer during the watershed-monitoring program conducted by GRI and GRWC from 1998 to 2001. Measurements were taken every 200' along the monitoring reach at the center of channel, left and right bank full and 50' into the riparian zone from bank full on the left and right bank. Center of channel measures the effect of the riparian zone on the stream. The measurement taken 50' inside the riparian zone, measures the condition of the riparian forest. This is important because in the wider channels it may be impossible to significantly affect the channel with riparian shade. Current forest practice rules target 85% canopy cover as a desirable post harvest condition within 75' of bank full.

A riparian vegetation inventory was conducted during the watershed-monitoring program conducted by GRI and GRWC from 1998 to 2001. Inventory plots using the Forest Projection System inventory design were located on both sides of the channel every 200'. Tree size, species, live crown ratio, distance to the stream were measured. In addition, understory vegetation, snags and down logs were measured.

For biotic parameters GRI used electro shocking conducted between 1988 and 2001 by DFG, snorkel surveys conducted by GRI between 1997 and 2001 and Macroinvertebrate surveys conducted by GRI in 2000.

The snorkel surveys are principally a presence absence survey with a rough estimate of abundance by age class. Dennis Halligan, a fisheries biologist working for Natural Resource Management, Inc, conducted all the surveys.

The macroinvertebrate samples were taken by Jon Lee, a third party expert and analyzed in his state certified lab. The use of macroinvertebrates as indicators of stream condition is a well accepted and long established method (Erman, N, 1991). An inventory of macroinvertebrate fauna in stream riffles can measure changes in chemical and physical stream properties. These changes ultimately determine the presence and distribution of resident biota (Usinger, 1956). Such an inventory is indicative of current as well as past environmental conditions. This method of sampling emphasizes the collection of bottom dwelling insects, which are relatively fixed in their habitat, unlike fish or plankton which can move to more favorable conditions (Usinger, 1965).

GRI used the "California Stream Bioassessment Procedure" (Cal. Dept. of Fish and Game, 1999). The following metrics (measures based on benthic macroinvertebrates in a benthic sample) suggested by the California Stream Bioassessment Procedure are currently being used to monitor streams on GRI properties.

Taxa Richness

This is a measure of the total number of distinct taxa within a sample. Macroinvertebrates are determined to the lowest practical taxonomic level (generally genus)as suggested by the CAMLnet Standard Taxonomic Effort (Cal. Dept. of Fish and Game, 2000). Taxa richness generally decreases with decreasing water quality (Weber, 1973; Resh and Grodhaus, 1983). (((Taxa richness generally increases with increasing water quality, habitat diversity, and/or habitat suitability (Plafkin et al.1989).))) The following table will help describe the quality of the stream in the coastal Mendocino region when Taxa Richness is used as a metric. (Personal Com. Jon Lee, 1994; Harrington et al., 1999) :

	Poor	Average	Good
Richness	<26	26 to 35	>35

Community Diversity Index

The most common measures of stream health are diversity indices. Diversity indices measure species richness rather than abundance. A healthy stream should exhibit high diversity evidenced by a large number of taxa without any one taxon dominating.

The Simpson diversity index is the most commonly used diversity index when addressing aquatic communities (Magurran, 1988, Rosenberg and Resh, 1992).

The Simpson index is based upon species dominance. The Simpson diversity index ranges from 0 - 1.0. As the index approaches 1.0, the more diverse the sample is thought to be. The following table will help describe the quality of the stream when the Simpson index is used (Personal Com. Jon Lee, 1994):

	Poor	Average	Good
Simpson Diversity Index	.7 to .79	.8 to .89	.9 to 1.0.

Percent Dominant Taxon

The Percent Dominant Taxon is the ratio of individuals in the most abundant taxon to the total number of organisms in the sample. A sample dominated by relatively few taxa would indicate environmental stress, as would a sample composed of several taxa but numerically dominated by only one or two. An abundance of taxa with a fairly equal distribution of individuals within the sample is indicative of community balance.

The following table will help describe the health of the stream when using Percent Contribution of the Dominant taxa (EPA 444/4-89-001) :

	Poor	Average	Good
% Contribution of Dominant Taxa	> 39 %	39 - 15 %	<15%

Biotic Index

The Hilsenhoff Index is a biotic index. This index weights the relative abundance of each taxon in terms of its organic pollution tolerance to determine a community score. Generally the higher the score the poorer the water quality (Hilsenhoff, 1982).

Index	Condition
0.85 to 1.75	Excellent
1.76 to 2.25	Very Good
2.26 to 2.75	Good
2.76 to 3.50	Fair
3.51 to 4.25	Poor
4.26 +	Very Poor

A tolerance value based on the Hilsenhoff Biotic Index is currently being used in the Pacific Northwest. Taxa tolerant of organic enrichment are also generally tolerant of warm water, fine sediment, and heavy filamentous algal growth (Wisseman 1996). The tolerance value is based on a scale of 0 (intolerant) to 10 (very tolerant).

The value is expected to increase with a stressed environment. The following table will help describe the health of a stream when using this tolerance value (Harrington et al. 1999):

	Poor	Average	Good
Tolerance Value	<4.6	4.6 to 3.1	>3.1

Abundance

This is rough estimate of the total number of macroinvertebrates per sample and hence per unit area of stream. Very low abundances would be considered a negative when evaluating the relative health of a stream.